PHYSIOLOGY OF THE CIRCULATION.*—In this useful work the author has aimed "at producing a comprehensive view of the circulation as it exists in the lowest vegetable and highest animal forms." He has "endeavored to prove by a variety of arguments that the circulation, whenever and wherever found, differs less in kind than in degree; that fluids may move in living tissues with or without vessels and hearts; that the circulation in an aggregation of vegetable cells is essentially the same as that which occurs in the tissues of our own bodies. As a chain is composed of links, all of which are formed on a common type and fit into each other, so the circulation in the lowest vegetables and animals gradually develops into that of the higher, until we reach man himself; the circulation in the one being relatively as perfect as in the other."

BULLETIN OF THE CORNELL UNIVERSITY.†—The first two numbers of this new periodical, a credit alike to the university and the officers, contains a report of a reconnoissance of the Lower Tapajos river, by Professor C. F. Hartt, and a finely illustrated paper by Mr. O. A. Derby on the Carboniferous Brachiopoda of Itaitúba, Rio Tapajos, Brazil. We hope the patrons of the University will sustain this valuable publication.

MANUAL OF METALLURGY.‡—The author of this excellent manual was a student of Dr. Percy, the distinguished metallurgist, from whose work the present one is in part compiled. It will evidently prove, as the author hopes, a useful auxiliary to the more voluminous works on this subject. It is amply illustrated.

BOTANY.

INSECTIVOROUS PLANTS.§—The leaf of Sarracenia is a trumpet-shaped tube, with an arched lid, covering, more or less completely, the mouth. The inside is furnished with a perfect *chevaux-de-frise* of retrorse bristles, commencing suddenly about an inch from

* The Physiology of the Circulation in Plants, in the Lower Animals, and in Man. By J. Bell Pettigrew. Illustrated by 150 engravings on wood. London. Macmillan & Co. 1874. 8vo, pp. 329.

† Bulletin of the Cornell University. (Science.) Vol. i, Nos. 1, 2. Ithaca, N. Y., 1874. 8vo, pp. 63, with 9 plates.

‡ A Manual of Metallurgy. By W. H. Greenwood. Vol. i. Fuel, Iron, Steel, Tin, Antimony, Arsenic, Bismuth and Platinum. Illustrated by 59 engravings. New York. G. P. Putnam's Sons. Advanced Science Series. No date. [1874] 12mo, pp. 260. $1.50.

§ Abstract of a paper read at the Hartford meeting of the Amer. Assoc. Adv. Science.

the base; thence decreasing in size until from about the middle to the mouth they are so short, dense, and compact, that they form a decurved pubescence which is perfectly smooth and velvety to the touch, especially as the finger passes downward. Under the hood again, many of them become large and coarse. Running up the front of the trumpet is a broad wing with an emarginate border, parting at the top and extending around the rim of the pitcher. Along this border, but especially for a short distance inside the mouth, and less conspicuously inside the lid, there exude drops of a sweetened, viscid fluid, which, as the leaf matures, is replaced by a white, papery, tasteless, or but slightly sweetened sediment or efflorescence; while at the smooth bottom of the pitcher is secreted a limpid fluid possessing toxic or inebriating qualities.

The insects which meet their death in this fluid are numerous, and of all orders. Ants are the principal victims, and the acidulous properties which their decomposing bodies give to the liquid doubtless render it all the more potent as a solvent. Scarcely any other Hymenoptera are found in the rotting mass, and it is an interesting fact that Dr. Mellichamp never found the little nectar-loving bee or other Mellifera about the plants. On one occasion only have I found in the pitcher the recognizable remains of a *Bombus*, and on one occasion only has he found the honey bee captured. Species belonging to all the other orders are captured, and among the larger species I have found katydids, locusts, crickets, cockroaches, flies, moths, and even butterflies in a more or less irrecognizable condition.

Two species are proof against the siren influences of the destroyer, and in turn oblige it, either directly or indirectly, to support them. The first is *Xanthoptera semicrocea* Guen., a little glossy moth which may be popularly called the Sarracenia moth. It walks with perfect impunity over the inner surface of the pitcher, and is frequently found in pairs within the pitchers soon after these open in the early part of the season, or about the end of April. The female lays her eggs singly near the mouth of the pitcher, and the young larva from the moment of hatching spins for itself a carpet of silk, and very soon closes up the mouth by drawing the rim together with a delicate gossamer-like web, which effectually debars all small outside intruders. It then begins fretting under the hood, feeding downward on the cellular tissue and leaving only the epidermis, and by the time the worm has attained

its full size the pitcher generally collapses. At this time the worm is beautifully colored, and is characterized by rows of tubercles, which are especially prominent on the four larger, legless joints. The chrysalis is formed in a very slight cocoon. The species, kindly determined by Mr. A. R. Grote, was many years ago figured by Abbot, who found it feeding on *Sarracenia variolaris* in Georgia. Guenée's descriptions were made from these figures, and here the author appends a few descriptive notes from the living material, of interest only to specialists on account of their technical character. The second insect which successfully braves captivation is a species of flesh-fly which the author names *Sarcophaga sarraceniæ*. After giving some technical details of structure, he shows how the larva of this fly riots in the putrid insect remains, and how, in order to undergo its transformations, it bores through the leaf and burrows into the ground. The immense prolificacy of these flesh-flies, and the fact that the young are hatched in the ovaries of the parent before they are deposited by her on tainted meat, are duly commented upon, as well as the rapid development of the species; also the propensity of the larvæ for killing one another and their ability to adapt themselves to different conditions of food-supply are made appreciable.

In conclusion the author says: To one accustomed to seek the why and wherefore of things the inquiry very naturally arises as to whether Xanthoptera and Sarcophaga play any necessary or important rôle in the economy of Sarracenia. Speaking of the Sarcophaga larva, Mr. Ravenel asks, "May he not do some service to Sarracenia as Pronuba does to Yucca?" And if so may not all this structure for the destruction of insects be primarily for his benefit? Can he be merely an intruder, sharing the store of provision which the plant, by ingenious contrivance, has secured for itself, or is he a welcome inmate and profitable tenant? Self-fertilization does not take place in Sarracenia, and the possibility that the bristly flesh-fly aids in the important act of pollination, lends interest to the facts. No one has witnessed with greater pleasure than myself the impulse which Darwin has of late years given to such inquiries, but the speculative spirit, is, in some quarters, becoming too wild and unbridled, and we should be cautious lest it impair our judgment or our ability to read the simple lesson of the facts. My own conclusions summed up are:

First: There is no reason to doubt, but every reason to believe

that Sarracenia is a truly insectivorous plant, and that by its secretions and structure it is eminently fitted to capture its prey.

Second: That those insects most easily digested (if I may use the term), and most useful to the plant, are principally ants and small flies, which are lured to their graves by the honeyed path, and that most of the larger insects, which are not attracted by sweets, get in by accident and fall victims to the peculiar mechanical structure of the pitcher.

Third: That the only benefit to the plant is from the liquid manure resulting from the putrescent captured insects, some of which doubtless descend to the root-stalk, and probably through large tubular cells, observed by Mr. Ravenel, passing through the petiole into the root.

Fourth: That Sarcophaga is a mere intruder, the larva sponging on and sharing the food obtained by the plant, and the fly attracted thither by the strong odor, as it is to all putrescent animal matter or to other plants, like *Stapelia variegata*, which give forth a similar odor. There is nothing to prove that it has anything to do with pollination, and the only insect that Dr. Mellichamp has observed about the flowers with any frequency, is a Cetoniid beetle — the *Euryomia melancholica.*

Fifth: That Xanthoptera has no other connection with the plant than that of a destroyer, though its greatest injury is done after the leaf has performed its most important functions. Almost every plant has its peculiar insect enemy, and Sarracenia, with all its dangers to insect life generally, is no exception to the rule.

Sixth: That neither the moth nor the fly have any structure peculiar to them, which enables them to brave the dangers of the plant, beyond what many other allied species possess. — C. V. Riley.

Distribution of American Woodlands.*— This is a paper to be published in the Statistical Atlas of the United States, now in progress of publication. It is an exhibition of a map, and a description of the methods by which the map was colored. Then follows an analysis of the trees of the tree flora in the ten districts into which the United States was divided. The flora of the United States, the author said, is believed to contain over 800

*Read at the Hartford Meeting of the Amer. Assoc. Adv. Science.

woody species, and over 300 trees. Of these trees about 250 species are somewhere tolerably abundant, about 120 species grow to a tolerably large size, 20 attain a height of 100 feet, 12 a height sometimes of over 200, and a few — perhaps 5 or 6 — a height of 300. The speaker analyzed the districts, adding: New England I consider to contain 80 or 85 species, of which 50 may reach a height of fifty feet; Maine is the great source of pine and spruce lumber, but as a whole the hard wood species predominate. Without going into the details of this flora, it is sufficient to give the author's remark that the area of woodland in New England is not perhaps greatly diminishing, but the amount of timber capable of being made into sawed lumber is lessening. The Middle States have about 100 to 105 species of trees, 65 to 67 of which sometimes reach 50 feet in height. Here were originally very heavy forests. There are still large areas heavily timbered, but the timber for all purposes is unquestionably rapidly diminishing, and there is no compensating influence going on for increase.

But in the Middle and New England States various hard woods attain their greatest perfection as to strength and durability; and as a consequence here we find the manufactures that are dependent on those woods. In the southeastern region — that is, extending from Virginia and Florida — we have about 130 species. In each case these form the conspicuous elements of the landscape. 75 attain a height of 50 feet or more, and about a dozen species a height of 100 feet. A belt of pine timber extends the whole length of this region, which is the great source of the hard and yellow pine. The author described the ornamental trees of that beautiful region, and resumed: The northwestern region, from Ohio to Minnesota, and north of the Ohio River, is represented by about 105 to 110 species, 68 or 70 of which may reach a height of fifty feet. That is the district furnishing at present the largest production of sawed lumber within the United States. Michigan alone furnished in 1870 of the 12,750,000 of M. feet, 2,250,000; Wisconsin furnished over 1,000,000 — the two states thus producing more than one-fourth of the whole yield returned in that year.

The author alluded to the rapidity of the destruction going on in that region; also of the diminution of sawing lumber in the forests, and the increase in woodland over the prairie region as it becomes cultivated. The southwestern region, extending from

Kentucky to Texas and the Gulf, has about 112 to 118 species, 60 or 65 of which attain a height of 50 feet, which the author also analyzed. West of these last two districts, this treeless belt, extending entirely across the continent from the Gulf of Mexico to the Arctic Ocean, is described, and its characteristics within the limits of the United States are mentioned. It is 350 miles wide in its narrowest part, between latitude 36° and 37°, and 800 miles wide on our northern border. The Rocky Mountain region is next considered. This consists of from 28 to 30 species, but a vastly smaller number making up the timber region. Perhaps not over half a dozen species constitute by far the larger part. No hard woods are abundant in any of the forests west of the Great Plains, although hard woods occur, particularly in the southern and western part, as scattered trees rather than as forests. Between the Rocky Mountains in the Sierra Nevada is a desert or sparsely wooded region, which extends southward to Mexico, uniting on its southern part with the treeless expanse which extends from the Atlantic to the Pacific along our southern frontier, and throwing out a spur entirely across the Rocky Mountains near the Pacific Railroad, connecting it with the treeless plains on the eastern side. This great treeless district varies very much in its different regions, has quite a large number of species of interest to botanists, and some few of economic value. The only forests within it are forests of coniferæ, occurring on the mountains, of which the largest one is in Arizona and is 400 miles long, the limits of which have recently been demonstrated by Lieut. Wheeler's Expeditions. Here followed an analysis by the author of the flora of the region west of this Desert; of California, Washington Territory, and Oregon, where were found the grandest forests, perhaps, on earth, and the noblest trees. The number of species of these latter is quite large, but in any one region the number of species is small. With one single exception all of the trees within the United States which attain a height of 200 feet are found in this district. The forests are entirely of cone bearing trees and the number of species is large, the number of timber trees being very large and their size and value also being great. In Washington Territory official reports state that the land will produce from 25,000 to 300,000 feet per acre, and that there are vast tracts "that would cover the entire surface with cord wood

10 feet in height." Then follows again an analysis of the trees of California and Oregon, including the many forms there that have been of interest in the world.

In Alaska, the tenth region or district, the data are insufficient for the map, but there are heavy forests there that are well known. The author rapidly discussed the original disposition of forests, showing what variety of causes have controlled this. Then the economic value of some of the industries directly dependent on them were alluded to, and the author ended his paper with some conclusions regarding the future supply, and suggestions regarding the planting of trees.—Wm. H. Brewer.

Adoxa Moschatellina L., in Iowa!—A correspondent in the Northeastern part of the state sent me some time since specimens which prove to be *Adoxa Moschatellina* L. Its locality is given in the "Flora of North America" as between lat. 54° and 64°, and on the higher peaks of the Rocky Mountains as far south as lat. 42°. Professors Porter and Coulter in the "Flora of Colorado" call it a "sub-alpine, common" plant. The last named gentleman collected it on Mt. Lincoln at the altitude of 13,000 feet. Mr. Watson in a private note says, "not found before this side of Colorado and the mountains, I believe."

Its occurrence in Iowa is certainly unlooked for. It grows abundantly on a rocky hillside, and was in bloom in May. Its locality in this case is best given as "Upper Iowa River, Iowa." —C. E. Bessey, *Agricultural College of Iowa*, Aug. 31, 1874.

Dispersion of Seeds by Shooting them off. — Our correspondent, Mr. Brandegee of Colorado, writes: —

"While drying seeds of *Ionidium lineare*, I noticed an interesting habit it has of shooting its seeds. Each capsule contains six seeds and is a six shooter. The three valves open wide and press the seeds tightly by their margins and in this way they are shot off singly, as one shoots orange seeds from between the fingers. A good shot will go fifteen to twenty feet."

All violets do it, and *Ionidium* is of this family. To render the operation clearer, it should be added that the three firm valves into which the capsule splits, after their separation fold together on their axis, to which the seeds are attached in a row, and it is the gradually increasing pressure so applied to the hard and smooth-coated ovoid seeds that fires them off. — Eds.

BOTRYCHIUM LUNARIA Swartz, was collected in Michigan long before the date given in the June NATURALIST by Mr. Gillman. In my herbarium are specimens collected on Isle Royale by Dr. A. E. Foote, in the summer of 1868.— C. E. BESSEY.

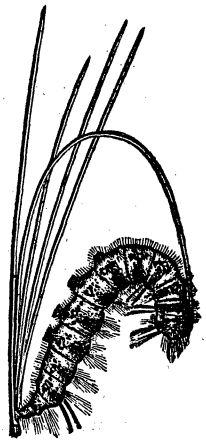
ZOOLOGY.

TRANSFORMATIONS OF OUR MOTHS.—Some interesting notes are given by Mr. J. A. Lintner in the "Twenty-sixth Annual Report on the New York State Cabinet of Natural History for 1872." He describes very fully the larva of *Eudryas unio* which feeds on *Epilobium coloratum*, and not on the grape, as stated by Fitch, and afterwards by Packard and Riley on Fitch's authority. Lintner gives characters for distinguishing the larvæ of *Eudryas unio* and *grata* as well as *Psychomorpha epimenis*, which so closely resembles Eudryas in its larval stage. The larvæ of *Parorgyia parallela* Gr. Rob., *Apatelodes angelica* Grote, *Cœlodasys unicornis* (Sm. Abb. Fig. 101), *Platycerura furcilla* Pack. (Fig. 102), *Dry-*

Fig. 101.

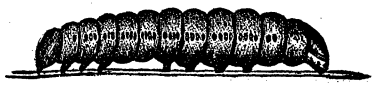
Larva of Cœlodasys unicornis.

Fig. 102.



Larva of Platycerura furcilla.

Fig. 103.



Larva of Nadata gibbosa.

Fig. 104.

Fig. 105.

Larva of Notodonta.

ocampa rubicunda Fabr., *Tolype Velleda* (Stoll), *Nadata gibbosa* (Sm. Abb. Fig. 103), and an unknown Notodonta (Fig. 104, Fig. 105, the same when feeding); also of *Cerura borealis* Boisd. (Fig. 106) and other Bombycid moths are described. Several